SAMPLING AND ANALYSIS PLAN

Correlating Radionuclide Activity in Resuspended Soil Particulate for Two Particle Size Partitions to Soil Reservoir Radionuclide Activity and Wind Speed

Final

Revision 0

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Table 1-1. ACRONYMS AND ABBREVIATIONS

AMES	Actinide Migration Evaluation Study
ASD	Analytical Services Division
AQM	Air Quality Management
Ci	Curies
cfm	cubic feet per minute
CL	centerline
cm	centimeters
cm^2	square centimeters
DOE	Department of Energy
DQO	data quality objective
EPA	Environmental Protection Agency
ft^3	cubic feet
g	grams
GIS/GPS	
in.	inch
KH	Kaiser-Hill Company
lpm	liters per minute
m	meter
m^2	square meters
m^3	cubic meters
m/s	maximum speed
μg	micrograms
mg	milligram
ml	milliliter
mm	millimeter
MRI	Midwest Research Institute
PCi	picoCuries
PM-10	particulate matter, <10 microns aerodynamic equivalent diameter
QA/QC	Quality Assurance / Quality Control
RIN	Report Identification Number
SAP	Sampling and Analysis Plan
Site	Rocky Flats Environmental Technology Site
TP	total particulate
TSP	total suspended particulate matter (PM10 plus all matter >PM10 that passes a No. 235 sieve)

1.0 INTRODUCTION

1.1 Purpose

To estimate the short-term and long-term impacts of the airborne resuspension of actinide-contaminated dust from Rocky Flats Environmental Technology Site (Site), the Actinide Migration Evaluation Study (AMES), with support from the Air Quality Management Program (AQM), has developed Site-specific dispersion models. One of the inputs to such models, which may be used to evaluate the effects of proposed soil clean-up levels, is the level of actinide activity in wind-derived dust from contaminated Site soils. This study proposes to quantify the relationship between actinide activity in the soil reservoir and the corresponding activity level in wind-derived dust emissions from those soil, using a portable wind tunnel to generate high winds and collect soil particles eroded from the exposed soil surface.

On the evening of July 10, 2000, a lightning strike in the Rocky Flats buffer zone ignited a wildfire. The fire was controlled after burning twenty acres of grassland east of the 903 Pad. By exposing the underlying soil, the wildfire created a unique opportunity to quantify the resuspension rate of actinide particles from the soil surface by wind, without the confounding effects of the dense vegetation and thatch that are common in the buffer zone. The exposed surface should release more soil particles to the winds created by the wind tunnel described below, improving dust sample collection and ensuring that analytical detection limits for most Site actinides may be reached.

Wind tunnel technology, provided by Midwest Research Institute (MRI), has been previously employed at the Site in characterizing surface soil erosion rate in the 2000 prescribed burn test plot and in characterizing surface erosion potential in the OU3 area. Staff from MRI, AQM, and AMES have Site experience with the equipment, procedures, and sample handling necessary to accomplish this scope of work. Actinide activity coefficients will be developed for resuspended dust in the 10 micron particle size cut (PM10), and for all captured airborne dust passing a 45 micron sieve (TSP, total suspended particulate), using optical particle counter data and gravimetric and isotopic analyses of the wind tunnel samples for two particle cut sizes combined with isotopic analyses of shallow soil samples collected to characterize the soil reservoir. By correlating surface soil actinide activity to particulate matter erosion rate and activity, new insight into the actinide migration mechanism in air will be achieved.

1.2 Background

One of the more controversial aspects of the Rocky Flats Closure Project is negotiating soil cleanup levels that are protective of public and environmental health while still being technically achievable and cost-effective. Any contamination remaining in Site soils following closure will continue to be acted upon by natural erosive forces such as surface water runoff and high winds. AMES and AQM staff have modeled the effects of wind across contaminated Site soils with reasonable success. However, the predictive ability of dispersion models is dependent on the representativeness of the model inputs. To date, when a resuspended dust air dispersion model has been run for Site sources, the activity in the airborne dust has been assumed to be the same as the activity in the underlying soil. This study will provide a unique comparison of airborne dust radioactivity at two particle size cuts to soil erosion potential (as influenced by soil moisture content and soil texture) and wind speed. The outcome is expected to improve the quality and accuracy of future modeling efforts to predict actinide release from Site surface soils under different wind speed conditions, and provide a better basis for understanding the uncertainty of modeled predictions.

The study area is located due south of the Site's east gate, in the buffer zone (see Figure 1-1). According to Site soil isopleths, plutonium concentration in the soil ranges between 1.0 and 10 pCi/g (see Figure 1-2). Though 10 pCi/g is well below the plutonium concentration that would necessitate posting this region as a radiological contamination area, 10 pCi/g may allow analytical detection of plutonium in the quantities sampled by the wind tunnel. This aspect of the soil, and the absence of dense vegetation due to the wildfire, are the principle characteristics of the study area that make it suitable for this work. In accordance with Site policies, no radiological work plan (RWP) or other controls are necessary to work in the study area.

The wind tunnel team has already completed a wind tunnel study of buffer zone soil erosion potential in April, May, and June 2000, using the prescribed burn test plot. A combined MRI/AQM wind tunnel team evaluated the erosion rates of exposed soils during post-fire vegetative recovery. While the proposed study will not duplicate in total the post-prescribed burn work, the operation of the sampling equipment will follow the same protocols as were successfully employed in the post-prescribed burn study (see Appendix A).

Because the proposed work will utilize a different, smaller wind tunnel than was used in the post-prescribed burn work, a calibration test comparing results from the two MRI tunnels under identical sampling conditions will be included in this study. The calibration test will involve operating the two tunnels on a homogenous, uniform surface through a series of test runs, with the particulate mass accumulation per unit surface area being compared to calibrate the smaller tunnel against the larger. The larger tunnel will not be employed in this study to protect it against the very slight possibility of radionuclide contamination from the study area.

2.0 SAMPLING RATIONALE

The successful wind tunnel study of the prescribed burn plot erosion potential and surface recovery rate serves as the model for this study. The systematic sampling strategy detailed in Section 4.0 is designed around the following expected conditions:

- Selective partitioning of actinide activity among resuspended dust particles as a function of two particle size ranges (TSP and PM10);
- Correlation between actinide activity in the surface soil reservoir and actinide activity in resuspended dust;
- Minimal vegetative interference with wind tunnel airflow due to slow post-wildfire recovery of the study area optimizing particle resuspension by the wind tunnel;
- Sufficient plutonium present in surface soils to allow for analytical detection in wind tunnel filter samples;
- Expected plutonium-239 (Pu239) concentrations in soil of 1.0 to 10 pCi/g;
- Expected americium 241 (Am241) concentrations in soil of 0.0 to 1.0 pCi/g;
- Expected uranium 234 (U234), uranium 235 (U235), and uranium 238 (U238) concentrations in surface soil at naturally-occurring background levels only; and
- Surface soil actinide concentrations well below levels of concern from a health and hygiene perspective.

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The conceptual model of actinide resuspension by wind prescribes that particle-bound actinides in the soil matrix airborne when wind velocity across the exposed soil surface exceeds the soil threshold velocity. Under dense vegetative cover, the effective threshold velocity increases due to the buffering effects of vegetation on wind speed at ground level. By designing this study for the wildfire plot, which has been effectively denuded of vegetation and thatch, we optimize resuspension potential.

3.0 DATA QUALITY OBJECTIVES

The data quality objective (DQO) process consists of seven steps and is designed to be iterative. Each of the seven steps is described below for the study area. Data requirements to support this investigation were developed and implemented in the project using criteria established in the *Guidance for the Data Quality Objective Process*, QA/G-4 (EPA 1994).

3.1 State the Problem

Air dispersion models allow for semi-quantitative predictions of the short-term and long-term impacts of resuspended actinides on downwind receptors. Our limited knowledge of the relationship between soil actinide concentrations and the corresponding concentrations of actinides in dust resuspended from the soil reservoir places limits on the confidence we assign to model predictions. The purpose of this study is to establish a relationship between the concentration of actinides in soils and the corresponding concentration of actinides in dust resuspended from those soils, as a function of airborne particle size. This relationship will allow for more accurate modeling of resuspended actinide dispersion.

3.2 Identify the Decision

Decisions to be made using the data collected from the wind tunnel study focus on determining the relationships between (1) actinide activity in the soil reservoir; (2) actinide activity in the particle-size segregated dust eroded from the same soil reservoir; and (3) particle mass erosion rate from the soil reservoir at a specific wind speed. The decisions will be based on answers to the following questions:

- What is the correlation between surface soil actinide activity and activity in PM10 eroded from the same soil reservoir?
- What is the correlation between surface soil actinide activity and activity in TSP eroded from the same soil reservoir?
- What is the correlation between particulate mass erosion rate and actinide activity in PM10 eroded from the same soil reservoir?
- What is the correlation between particulate mass erosion rate and actinide activity in TSP eroded from the same soil reservoir?

3.3 Identify Inputs to the Decision

Inputs to the decision include analytical results from soil and wind tunnel filter samples. Analytical parameters of interest are detailed in Section 4.4. Wind tunnel samples will be collected in accordance with this Plan. Soil samples will be collected in accordance with CAS SOP-003,

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Sampling for Waste Characterization for General Sampling Activities at the Rocky Flats Environmental Technology Site.

3.4 Define the Boundaries

The investigative boundaries and rationale are detailed in Section 4 of this Plan. Investigative boundaries coincide approximately with the perimeter of the 10 July 2000 wildfire area, with the exception of the "side-by-side" calibration of the smaller wind tunnel to the benchmark wind tunnel, which will take place on a buffer zone road near the 60-meter meteorological tower.

3.5 Decision Rule

If the correlation of resuspended activity to soil actinide activity is other than 1:1 for either size fraction, future modeling will reflect the actual correlation. If the correlation of resuspended activity to resuspension rate is not consistent with the modeling assumptions used to date, an evaluation of the potential impacts of variation in this input will be necessary.

3.6 Limits on Decision Errors

Additional characterization of the relationship of resuspended dust actinide activity to soil reservoir activity as a function of resuspension rate and size distribution may be necessary before applying the results of a single-location study to a broad range of Site locations. However, the usefulness of even one Site-specific data set cannot be overemphasized given the current lack of knowledge. To maximize the usefulness of the study, a laboratory data evaluation utilizing precision, accuracy, representativeness, completeness, and comparability parameters and data validation will be included in this study. Data validation is typically performed on 25% of the laboratory sample population.

3.7 Optimize the Design

In the event that further study is required to evaluate the relationship between soil actinide concentration and resuspended actinide activity, the results of this investigation and the prescribed burn, information from the test burn wind tunnel study will be used to design additional field studies. A separate SAP will be developed for such work.

4.0 SAMPLING ACTIVITIES AND METHODOLOGY

4.1 Sampling Site Location

The wind tunnel samples will be collected from the plateau and northern downslope of the wildfire plot, in the south buffer zone (see Figure 1-1). The exact sampling points will be determined in the field, based on small-scale topology and vegetation density judgements by the sampling team (the wind tunnel requires a relatively level, uniform surface to optimize results). The wind tunnel study plots will be demarcated with pin flags for later plotting in accordance with Site GIS/GPS protocols.

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Soil samples will be collected from areas contiguous to the wind tunnel study plots, without overlapping. Soil sampling locations will be demarcated with pin flags for later plotting in accordance with Site GIS/GPS protocols.

Calibration of the smaller wind tunnel to the larger reference wind tunnel will take place within the same test plot on the buffer zone road adjacent to the 60-meter meteorological tower, north or northwest of the new landfill (see Figure 4-2). The road will be temporarily closed with the support of the Site buffer zone manager. The road surface will be raked to maximize uniformity and homogeneity.

4.2 Sampling Design

4.2.1 Soil Sampling

Soil samples will be collected in accordance with CAS SOP-003, *Sampling for Waste Characterization for General Sampling Activities at the Rocky Flats Environmental Technology Site*, and the field sieving procedure of Section 13.2.5, "Industrial Wind Erosion," of *EPA Emission Factor Handbook, AP-42*. A surface soil sample of approximately 1000 milliliters (ml) dry volume will be sieved in the field to determine the particle size partitioning of study area soil. The following particle size ranges will be used to segregate size fractions: (1) >589 μm (on No. 30 standard sieve); 75 μm – 589 μm (on No. 200 standard sieve); and (3) < 75 μm (passing No. 200 standard sieve). The sieved sample will be weighed in the field to determine the mass ratio of each size fraction to the total mass.

(208g sample) Mass ratio: >589 110.7g; 589-75 82.3g; <75 15.0g

Sample locators selected based on absence of cover or thatch & nearness to WT study.

Once the mass fractions of the three particle size ranges have been determined, 125 ml of each size fraction will be bottled for isotopic analysis, Three additional sets of size-partitioned soil samples for isotopic analysis will be taken, bracketing the sampling area, for a total sample population of twelve (four sets of three particle size cuts each). Each sample will be "swept" from the surface layer rather than excavated from depth to better represent the reservoir of material available for resuspension by the wind tunnel. Sample containers will be provided by the Site soil sampling team. Table 4-1 summarizes the sampling design for all media. About 8 bowls per batch, each bowl about 250g. Bottles are integrated over all bowls.

4.2.2 Wind Tunnel Calibration

The benchmark wind tunnel used in the prescribed burn study will be used to calibrate the smaller wind tunnel being brought on Site for this study. This will be accomplished by operating both wind tunnels on a uniform, homogenous surface and comparing the gravimetric analysis of captured, resuspended dust to develop a curve correlating the small wind tunnel data to corresponding data from the benchmark tunnel. Results will be assessed in particulate mass eroded per unit surface area for wind speeds between threshold velocity and the maximum wind speed able to be generated in the smaller wind tunnel. 2/filter for 1st run of small tunnel only, then 1/f[illegible]

The calibration test will be comprised of <u>two test runs per tunnel</u>. Each test run will include two test areas, similar to the three-areas-per-run protocol followed for the post-prescribed burn work (the expected dustiness of the road surface sampled during calibration testing should produce greater filter loading over a smaller area than was necessary for the prescribed burn testing). Using optical particle counter data and filter gravimetric data, curves of the resuspension rate per unit area may be plotted and a coefficient developed for any corresponding points in each wind tunnel [illegible]

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velocity profile. This will allow the prescribed burn area study and wildfire area study to be correlated despite the dissimilar wind tunnel equipment. The calibration test will use conditioned quartz filters identical to those employed in the prescribed burn protocols, which will be provided and analyzed by MRI. Table 4-1 summarizes the sampling design for all media.

4.2.3 Wind Tunnel Sampling

Wind tunnel samples will be collected in accordance with *MRI Portable Wind Tunnel Test Method* (see Appendix A). This protocol was observed for the prescribed burn test burn work and yielded reliable results in a safe and effective manner. The prescribed burn test design will be modified to include four tests of six test areas each. The increase in test area per test is intended to maximize filter loading, optimizing the likelihood of exceeding minimum detection levels for actinides.

Each test will produce a filter sample of PM10 and a cyclone catch of particles >PM10. The combined mass from the filter sample and the cyclone catch constitutes TSP. Each filter comprises a coherent sample of resuspended PM10. The cyclone catch will be sieved into a tared Whirl-Pak in the field using a No. 325 sieve (45 μm screen openings). The sieved cyclone catch, when combined with the PM10 catch on the cyclone filter, will represent total suspended particulate matter (TSP), approximating PM30. Conditioned, tared fiberglass filters will be provided by AQM; No. 325 sieve and Whirl-Paks will be provided by MRI. Table 4-1 summarizes the sampling design for all media.

Table 4-1. Sample Design Summary

Activity	Sample Media	Analytes	Sampling Protocol
Soil sampling	Sieved surface soil in 125 ml bottles	Mass of size fractions: > 0.5 mm; 0.75 μm – 0.5 mm; < 0.75 μm	CAS SOP-003 AP-42, §13.2.5 Field gravimetry
		Isotopes[1]	Alpha spectrometry
Wind tunnel calibration	PM10 on 8x10 quartz filter	Mass	MRI Portable Wind Tunnel Test Method
MRI 73..84	TSP in cyclone, sieved into tared Whirl-Pak	Mass	
Wind tunnel sampling CB-20.. CB-24	PM10 on 8x10 glass fiber filter	Mass	MRI Portable Wind Tunnel Test Method
		Isotopes[1]	
	TSP in cyclone, sieved into tared Whirl-Pak	Mass	
		Isotopes[1]	Alpha spectrometry

Notes: [1] "Isotopes" refers to concentration of Pu-239, Am-241, U-234, U-235, U-238

4.3 Sample Designation

The Site standard sample numbering system will be used for samples entered into the Analytical Services Division (ASD) system. For soil samples, a standard RIN sample number will be assigned by ASD and individual event and bottle numbers will be assigned by the soil sampling team. For wind tunnel samples, a standard RIN sample number will be assigned by ASD. Individual event and bottle numbers will be assigned by the wind tunnel team. Wind tunnel samples will also be assigned sample number by MRI, which will be recorded in the project notebook by the wind tunnel team. For wind tunnel calibration tests, sample numbers will be assigned by MRI; samples will not utilize the ASD system for analysis. All sample designations, regardless of source, will be cross-referenced by AQM in the record of this study.

4.4 Sample Handling and Analysis

Sample handling will be consistent with EPA and industry standard practices for air samples. Chain of custody will be documented through chain-of-custody forms in accordance with Site protocols. Samples will be tracked, evaluated, and released for analysis in accordance with Site sample release protocols.

Soil samples will be shipped to Sanford, Cohen and Associates for isotopic analysis using Site-standard ASD protocols. Release evaluations will be completed prior to shipment. Wind tunnel calibration samples will be free-released and retained by MRI. MRI will analyze these samples in their laboratory, to ensure consistency with the prescribed burn analytical work which they also performed. Wind tunnel glass fiber filter samples will be equilibrated under laboratory conditions and weighed on Site by ThermoNuTech. These samples will be shipped to Sanford, Cohen and Associates for isotopic analysis using standard ASD protocols. Release evaluations will be completed prior to shipment.

The following tables summarize the analytical requirements for this study:

Table 4-2. Analytical Requirements for Wind Tunnel Study: Soil Samples

Matrix	Analytical Method	Analyte	Absolute Detection Limit[1,2]	Sample Detection Limit
Soil	Alpha Spectrometry	Am-241	0.3 pCi/g	0.3 pCi/g
		Pu-239	0.3 pCi/g	0.3 pCi/g
		U-234	1.0 pCi/g	1.0 pCi/g
		U-235	1.0 pCi/g	1.0 pCi/g
		U-238	1.0 pCi/g	1.0 pCi/g
	Gravimetric	Mass fraction	2 mg/sample	2 mg/sample

Notes: [1] Based on ASD Module tables. Assume 125 ml minimum sample size.

Table 4-3. Analytical Requirements for Wind Tunnel Study: Wind Tunnel Samples, Filters

Matrix	Analytical Method	Analyte	Absolute Detection Limit[1,2]	Sample Detection Limit[3]	Minimum Filter Load[4]
Glass fiber filter	Alpha Spectrometry	Am-241	0.07 dpm/filter	6.96E-4 pCi/m^3	8 mg
		Pu-239	0.07 dpm/filter	6.96E-4 pCi/m^3	8 mg
		U-234	0.5 dpm/filter	4.97E-3 pCi/m^3	57 mg
		U-235	0.5 dpm/filter	4.97E-3 pCi/m^3	57 mg
		U-238	0.5 dpm/filter	4.97E-3 pCi/m^3	57 mg
	Gravimetric	Mass	2 mg/filter	1.25 μg/m^3	

Notes: [1] Isotopic detection limits based on communication between ASD and laboratory
[2] Gravimetric detection based on industry standards
[3] ((0.45 pCi/dpm)x(absolute detection limit in dpm/filter)x(1 ft^3/0.0283 m^3))/((40 cfm sample rate)x(40 minutes/filter)) for isotopic analysis

[4] Assuming 4 pCi/g of each isotope in resuspended dust, then:
(1000 mg/g)x(absolute detection limit in dpm/filter)x(1 pCi/2.22 dpm)x(1 g dust/4 pCi)

Table 4-4. Analytical Requirements for Wind Tunnel Study: Wind Tunnel Samples, Cyclone

Matrix	Analytical Method	Analyte	Absolute Detection Limit[1]	Sample Detection Limit[1]	Minimum Sample Mass
TSP as soil[2]	Alpha Spectrometry	Am-241	0.67 pCi/g	0.67 pCi/g	10 mg
		Pu-239	0.67 pCi/g	0.67 pCi/g	10 mg
		U-234	2.2 pCi/g	2.2 pCi/g	10 mg
		U-235	2.2 pCi/g	2.2 pCi/g	10 mg
		U-238	2.2 pCi/g	2.2 pCi/g	10 mg
	Gravimetric	Mass	2.0 mg/sample	1.25 $\mu g/m^3$	

Notes: [1] Isotopic detection limits based on conversation with laboratory, assuming 10 mg sample size
[2] For analytical purposes, the TSP catch contained in Whirl-Paks will be submitted for analysis as soil sample, vice air sample, to allow standard Site analytical procedures to be followed.

Table 4-5. Analytical Requirements for Wind Tunnel Study: Calibration Test

Matrix	Analytical Method	Analyte	Absolute Detection Limit[1]	Sample Detection Limit
Quartz filter	Gravimetric	Mass	2.0 mg/filter	1.25 $\mu g/m^3$
Cyclone catch	Gravimetric	Mass	2.0 mg/sample	1.25 $\mu g/m^3$

Notes: [1] Based on industry standards

4.5 Equipment Decontamination and Waste Handling

Though the likelihood of contamination is very low, given the low soil concentrations of actinides in the study area, the possibility cannot be completely ignored. If necessary, field equipment will be decontaminated in accordance with procedure 4-S01-ENV-OPS-F0.03, *Field Decontamination Operations*. If contamination cannot be removed through field procedures, then procedure OPS-PRO-070, *Decontamination of Equipment at Decontamination Facilities* will be employed. No waste generation is expected from this study, other than samples which shall become the disposal responsibility of the off-site laboratories receiving them.

5.0 DATA MANAGEMENT

Project logbooks will be created and maintained by the project manager and/or a designee from MRI. The logbook will record the time and date of all field activities, sample locations, and any additional pertinent information not specifically required by the SAP.

Analytical data storage for this project will be divided between ASD and MRI, with each having responsibility for the analytical services performed under their respective contracts. Analytical results will be expected within 30 days of delivery to the respective laboratories.

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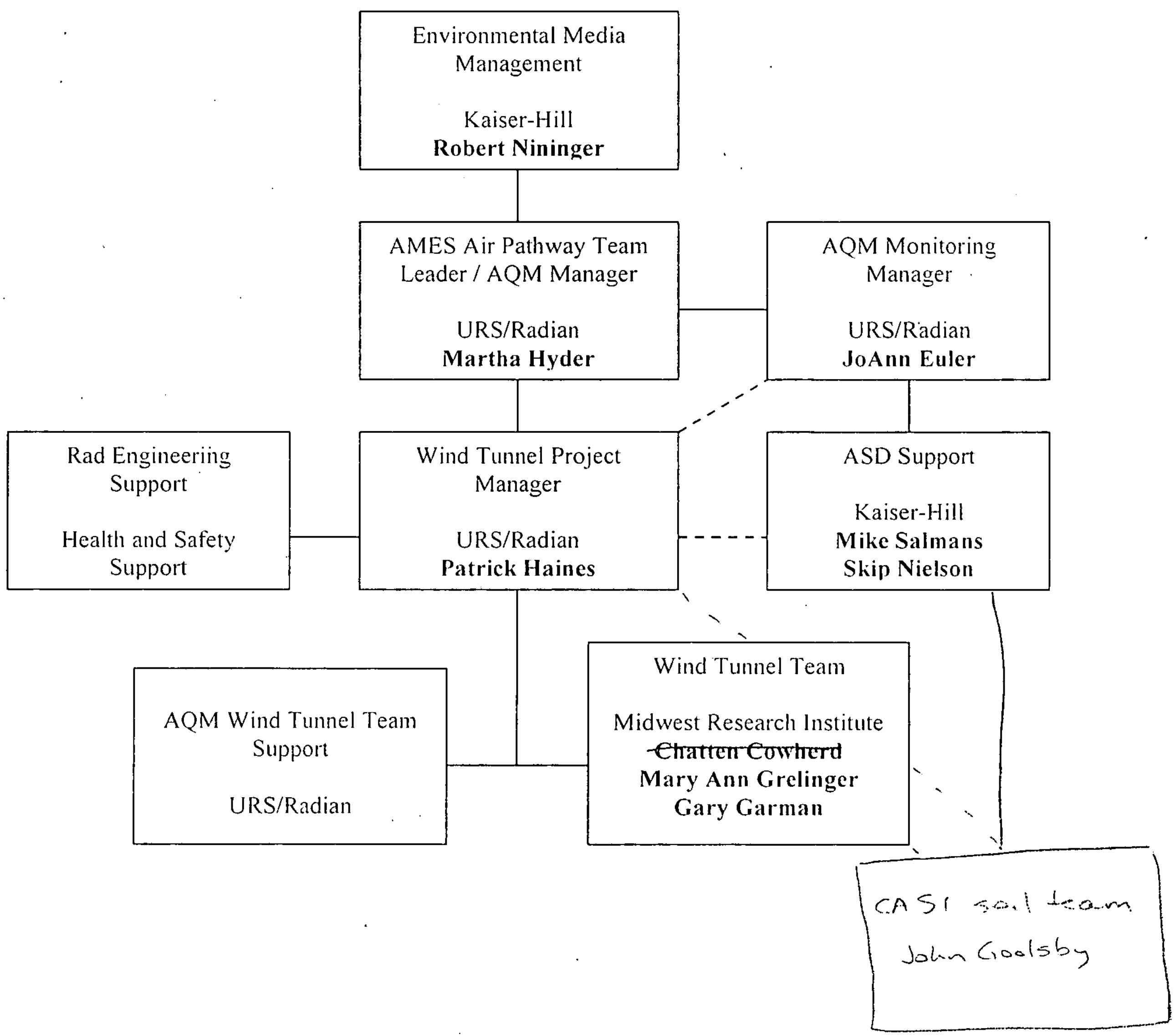
6.0 PROJECT ORGANIZATION

The task of determining the relationship between actinide activity of the surface soil reservoir and actinide activity of the resuspended soil as a function of particle-size has been assigned to the air pathway team within AMES. With assistance from AQM, the air pathway team has located the expertise necessary to answer these questions in MRI. MRI will operate under contract to AQM/AMES air pathway team. Figure 6-1 illustrates the project organization:

Figure 6-1. Project Organization



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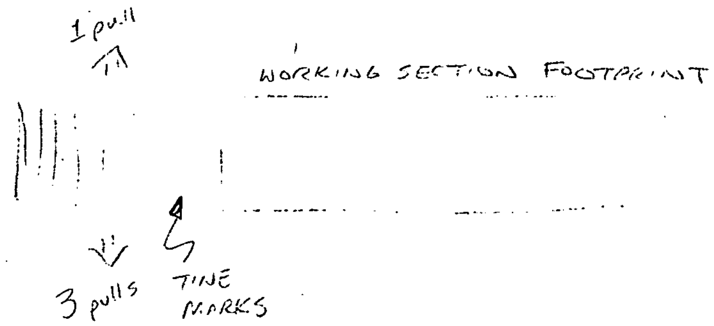
FIRST & SECOND TEST

PREPARATION OF SURFACE:

① Clip grass to ground level

② Rake @ 90° angle to air flow, both directions:



This removed thatch & broke surface crust to ensure good sample collection -- artificial & worst-case, but ensured good detection Q.

About 1 - 1.5 cm penetration depth with rake, same as soil samples.

Simulates disturbance following fire/devegetation.

THIRD & FOURTH TEST

① Clip grass to ground level / No crust disturbance

7.0 QUALITY ASSURANCE

7.1 Documentation

A field QA/QC program will be followed to ensure that data quality objectives are met. Sample collection errors will be controlled using standard collection methods, a dedicated field notebook, and chain-of-custody logs. Samples will be labeled with the project name, sample identification number, analytical method, sampler's name and initials, and date and time of collection. Chain-of-custody logs will reflect the same information as sample labels (see Appendix 3). Site analytical services will follow established Site procedures in tracking samples to and data from the analytical laboratories and providing data quality assurance.

7.2 Blanks and Duplicates

A blank population equal to 10% of the sample population for each air filter sample will be submitted for analysis. Blank corrections will be performed in accordance with approved Site data analysis procedures. Duplicate analyses will be conducted during analyses in accordance with the established analytical quality programs currently in use by the laboratories contracted to perform this work.

8.0 SCHEDULE

The wind tunnel study is scheduled for the week of 21 August 2000. The detailed schedule is as follows:

Table 8-1. Project Schedule

Date	Events
Monday, 8/21/00	MRI team arrives; calibration and functional checks of equipment; pre-survey of equipment; walkdown of sampling locations
Tuesday, 8/22/00	Side-by-side wind tunnel calibration testing
Wednesday, 8/23/00	Two wind tunnel tests, soil sampling
Thursday, 8/24/00	Two wind tunnel tests
Friday, 8/25/00	Contingency day

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9.0 REFERENCES

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APPENDIX A

THE MRI PORTABLE WIND TUNNEL TEST METHOD

Midwest Research Institute (MRI) portable wind tunnel (e.g., Figure ***) allows for direct characterization of the mass rate and particle size distribution of the emissions, including total particulate matter (TP) and PM-10, from the portion of the test plot that lies within the boundaries of the open-floored "working section" of the tunnel. Each test includes determination of the threshold friction velocity and the measurement of the erosion potentials for total particulate (TP) and PM-10 emissions at a reference wind speed above the threshold velocity. Tests are performed when natural ambient winds are light or moderate, i.e., below the threshold velocity of the surrounding soil so that areawide background particulate levels are low. A continuous particle mass monitor is used to track the time dependence of the emission rate as the wind speed in the tunnel is rapidly increased through the threshold velocity to the target wind flow, which is maintained during the sampling period. Analysis of velocity profiles in the wind tunnel is used to calculate the friction velocity for each test wind speed.

The PM-10 control efficiency of a particular treatment method is determined by comparing (a) the erosion potential of the treated soil surface at a specified wind speed above the threshold value, and (b) the erosion potential of the untreated soil surface at the same wind speed.

Summary of Test Method

The MRI portable pull-through wind tunnel, as described in the *Air/Superfund National Technical Guidance Study Series, Volume II, Estimates of Baseline Air Emissions at Superfund Sites* (EPA, 1989). It features all of the required design and operating characteristics, including the equipment for extracting isokinetic samples of wind generated particulate matter for measurement of mass emissions and particle size distribution. It is powered by a gasoline engine with direct mechanical linkage to the primary blower, which pulls the airflow through the tunnel.

In operating the wind tunnel, the open-floored test section is placed directly over the surface to be tested. Air is drawn through the tunnel at controlled velocities. The exit air stream from the test section passes through a circular duct fitted with a sampling probe near the downstream end. Air is drawn through the probe by a high-volume sampling train. Interchangeable probe tips are sized for isokinetic sampling.

A high-volume ambient air sampler is operated near the inlet of the wind tunnel to provide for measurement and subtraction of the contribution of the ambient background particulate level. By sampling under light ambient wind conditions, background interferences from upwind erosion sources can be minimized.

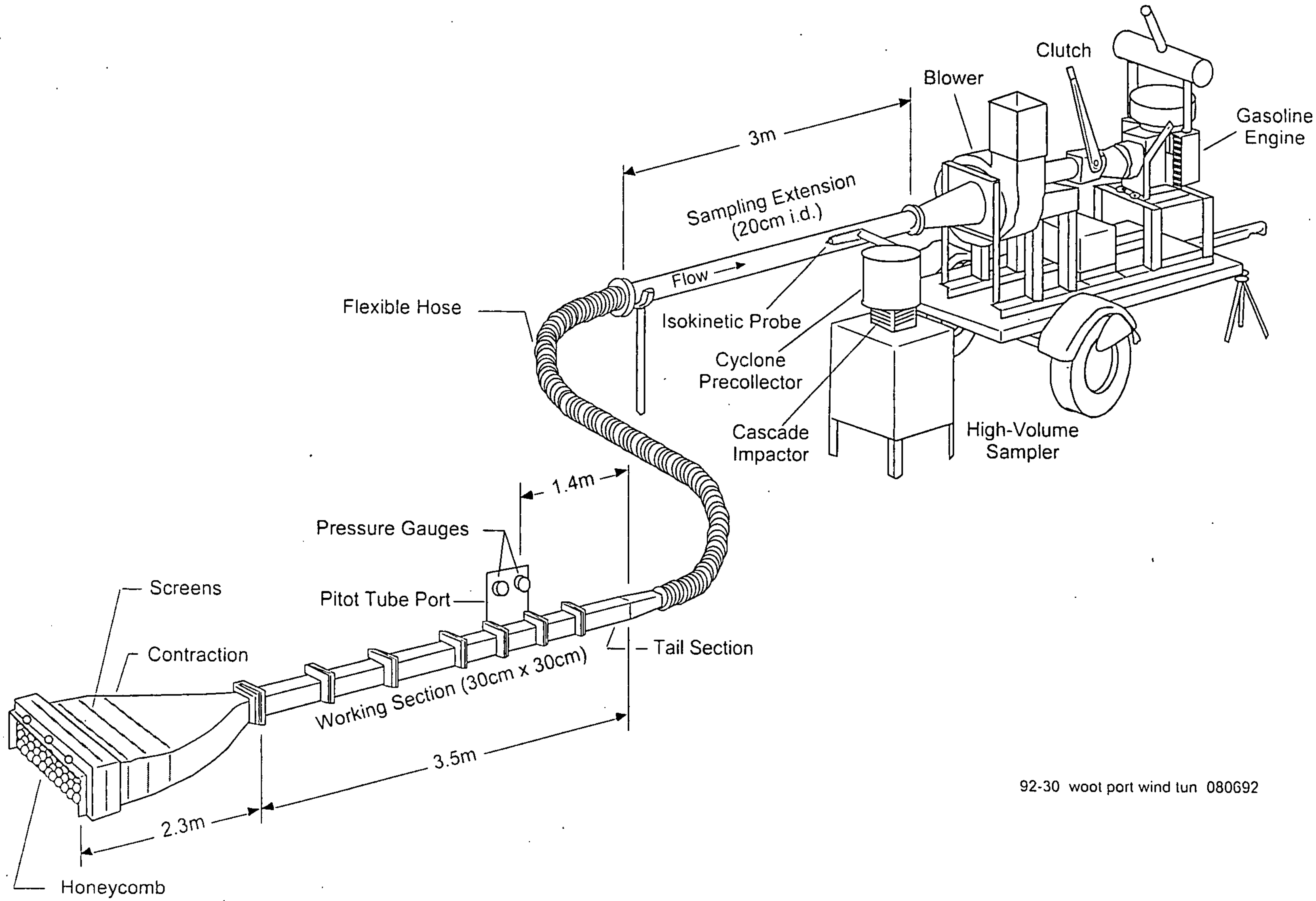

Figure *. MRI Portable Wind Tunnel**

The wind tunnel method relies on a straightforward mass balance technique for calculation of emission rate. No assumptions about plume configuration are required.

This technique provides for precise study of the wind erosion process on specific test surfaces and for a wide range of wind speeds. Previous wind erosion studies using the MRI wind tunnel have led to the EPA recommended emission factors presented in *Compilation of Air Pollutant Emission Factors (AP-42)*, published by U.S. EPA (1995).

Wind Tunnel Sampling Equipment

The MRI reference wind tunnel is identical in design to that developed by Gillette (1978) but is nearly twice as large. It consists of a two-dimensional 5:1 contraction section, an open-floored test section, and a roughly conical diffuser. The larger test area of this tunnel (30 cm x 3.5 m) provides for its use on rougher surfaces. The tunnel centerline airflow is adjustable up to an approximate maximum speed of 19 m/s (40 mph), as measured by a pitot tube at the downstream end of the test section. The equivalent wind speed at a reference height of 10 m above the ground is approximately twice the speed at the tunnel centerline.

A smaller MRI wind tunnel has the same general characteristics as the larger MRI reference wind tunnel. The major difference is that the tested surface area is approximately 35% of that of the reference wind tunnel (*i.e., 4.0 square feet as compared to 11.5 square feet). The smaller wind tunnel utilizes the same particulate matter sampling techniques as the larger tunnel.

Although the portable wind tunnel does not generate the larger scales of turbulent motion found in the atmosphere, the turbulent boundary layer formed within the tunnel simulates the smaller scales of atmospheric turbulence. It is the smaller scale turbulence that penetrates the wind flow in direct contact with the erodible surface and contributes to the particle entrainment mechanisms.

The wind speed profiles near the test surface (tunnel floor) and the walls of the tunnel have been shown to follow a logarithmic distribution (Gillette, 1978):

$$u(z) = \frac{u^*}{0.4} \ln \frac{z}{z_0} \qquad (1)$$

where: u = wind speed, cm/s
u^* = friction velocity, cm/s
z = height above test surface, cm
z_0 = roughness height, cm

The friction velocity, which is a measure of wind shear at the erodible surface, characterizes the capacity of the wind to cause surface particle movement. As indicated from Equation 1, the wind velocity at any fixed height above the surface (but below the centerline of the wind tunnel) is proportional to the friction velocity. The "micro-scale" roughness height of each test surface is determined by extrapolation of the logarithmic wind speed profile near the surface to where $u = 0$.

An emissions sampling module provides for representative extraction and aerodynamic sizing of particulate emissions generated by wind erosion. The sampling module is located between the tunnel outlet hose and the fan inlet. The particulate sampling train, which is operated at 69 m^3/h (40 acfm), consists of a tapered probe, cyclone precollector, quartz fiber backup filter, and high-volume motor. The sampling intake is pointed into the air stream, and the sampling velocity is adjusted to the approaching air speed by fitting the intake with a nozzle of appropriate size.

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When operated at 69 m^3/h (40 cfm), the cyclone has a nominal cutpoint of 10 μm aerodynamic diameter, based on laboratory calibration (Baxter et al., 1986). Thus the particulate fraction that penetrates the cyclone constitutes PM-10.

A pitot tube is used to measure the centerline (CL) wind speed in the sampling duct, upstream of the point where the sampling probe is installed. The volumetric flow rate through the wind tunnel is determined from a published relationship (Owen and Pankhurst, 1969) between the centerline (maximum) velocity in a circular duct and the average velocity, as a function of Reynolds' number. Because the ratio of the centerline wind speed in the sampling duct to the centerline wind speed in the test section is nearly independent of flow rate, the ratio can be used to determine isokinetic sampling conditions for any flow rate in the tunnel.

A portable high-volume air sampler with an open-faced glass fiber filter is operated on top of the tunnel inlet section to measure background dust levels. The filter is vertically oriented parallel to the tunnel inlet face.

Wind Tunnel Sampling Procedure

Prior to each test series, the test section of the tunnel is placed directly on the selected test surface. To prevent air infiltration under the sides of the open-floored section, the rubberized skirts, attached to the bottom edges of the tunnel sides are stretched out on the surface adjacent to the test surface. Rubber inner tubes filled with sand are laid along the skirts to assure a tight seal.

With the tunnel in place, the airflow is gradually increased to the threshold for the onset of wind erosion, as determined by visual observation of migration of coarse particles, and then reduced slightly. At the sub-threshold flow, a wind speed profile is measured and a surface roughness height is determined. The measured micro-scale roughness height allows for conversion of the tunnel centerline wind speed to the equivalent friction velocity and to the equivalent wind speed at a standard 10-m height, using the logarithmic wind speed profile. If the terrain roughness (rolling hills, vegetation, etc.) is much larger than the microscale roughness of the test plot, separate areawide roughness height reflecting the larger terrain features is used to convert the tunnel centerline wind speed to the equivalent wind speed at a standard 10-m height.

Sampling is initiated just after the tunnel centerline wind speed reaches the first prescribed super-threshold level corresponding to the desired friction velocity or wind speed corrected to a height of 10 m. After the prescribed sampling period, the flow is shut off and the particulate samples (cyclone catch and glass fiber backup filter) are removed. Then with the tunnel in the same position, additional tests of the same surface may be performed at successively higher wind speeds up the flow capacity of the tunnel.

At the end of each test, the sampling train is disassembled and taken to the field instrument van, and the collected samples of dust emissions are carefully placed in protective containers. After transfer of samples to a laboratory setting, high-volume filters are placed in individual protective envelopes or in specially designed carrier cases. Dust is transferred from the cyclone precollector by brushing it into a tared clear, resealable plastic pouch.

Dust samples from the field tests are returned to an environmentally controlled laboratory for gravimetric analysis. Glass fiber filters are conditioned at constant temperature (23°C ± 1°C) and relative humidity (45% ± 5%) for 24 h prior to weighing (the same conditioning procedure as used before taring). The particulate catch from the cyclone precollector is weighed in the tared pouch.

The raw test data that are recorded include the following:

- Site code and description
- Test date, run number, and type of test
- Start time and sampling duration

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- Threshold wind speed at tunnel centerline
- Subthreshold wind speed profile from which microscale roughness height is determined
- Operating wind speeds at tunnel centerline and at centerline of sampling tube
- Sampling module flow rate
- Ambient meteorology (wind speed and direction; temperature; barometric pressure)

Wind Tunnel Test Results and Interpretation

Because wind erosion is an avalanching process, it is reasonable to assume that the loss rate from the surface is proportional to the amount of erodible material remaining:

$$\frac{dM}{dt} = -kM \tag{2}$$

where: M = quantity of erodible material present on the surface at any time, g/m^2
k = proportionality constant, s^{-1}
t = cumulative erosion, time, s

Integration of Equation 2 yields:

$$M = M_o e^{-kt} \tag{3}$$

where M_o = erosion potential, i.e, quantity of erodible material present on the surface before the onset of erosion, g/m^2

The loss of erodible material (g/m^2) from the exposed surface area during a test is calculated as follows:

$$L = \frac{CQt}{A} \tag{4}$$

where: C = average particulate concentration in tunnel exit stream (after subtraction of background concentration), g/m^2
Q = tunnel flow rate, m^3/s
A = exposed test surface area = 0.918 m^2

Consistent with Equation 3, the erosion potential at a given wind speed may be calculated from the losses of erodible material from the test surface for two erosion times:

$$\frac{\ln\left(\frac{M_o - L_1}{M_o}\right)}{\ln\left(\frac{M_o - L_2}{M_o}\right)} = \frac{L_1}{L_2} \tag{5}$$

where: L_1 = mass loss during time period, 0 to t_1, g/m^2
L_2 = mass loss during time period, 0 to t_2, g/m^2

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An iterative procedure is required to calculate erosion potential from Equation 5 after substitution of two cumulative loss values and erosion times obtained from back-to-back testing of the same surface at the specified wind speed.

Alternatively, a continuous particulate concentration monitor connected to the sampling train can be used to project the erosion potential against the cumulative particulate catches from a given test run. In the case of the subject study, a TSI DustTRAK Aerosol Monitor continuously sampled air between the cyclone and the backup filter for the purpose of tracking the approximate PM-10 concentration in the tunnel effluent. Based on typical DustTRAK concentration records, the particle loss from a "limited reservoir" test surface after approximately 4 minutes of run time is equivalent to the full erosion potential for the surface at the given tunnel air flow rate.

Whenever a surface is tested at sequentially increasing wind speeds, the measured losses from the lower speeds are added to the losses at the next higher speed and so on. This reflects the hypothesis that, if the lower speeds had not been tested beforehand, correspondingly greater losses would have occurred at the higher speeds.

Emissions generated by wind erosion are dependent on the frequency of disturbance of the erodible surface because each time that a surface is disturbed, its erosion potential is restored. A disturbance is defined as an action which results in the exposure of fresh surface material. On a soil surface, this would occur whenever soil is either added to or removed from the old surface, or whenever surface material is turned over to a depth exceeding the size of the largest pieces of aggregate present in the soil.

In summary, the calculated test results for each test surface and wind speed include:

- Roughness height (microscale): from extrapolated subthreshold velocity profile
- Friction velocity: from measured centerline wind speed and roughness height, using Equation 1
- Equivalent wind speed at reference 10-m height: from measured centerline wind speed and roughness height, using Equation 1
- Erosion potential (for "limited reservoir" surfaces): equivalent to the cumulative particle mass loss after approximately 4 minutes of run time

Quality Assurance

Based on the results of replicate emission characterization of a defined test material (Cowherd, 1993), the precision of erosion potential measurements with the MRI portable wind tunnel may be expressed in terms of a relative standard deviation (standard deviation divided by mean value) of 14 percent.

References

Baxter, T. E., D. D. Lane, C. Cowherd, Jr., and F. Pendleton (1986). "Calibration of a Cyclone for Monitoring Inhalable Particulates." *Journal of Envir. Engineering*, 112(3), 468.

Chepil, W. S., (1952). "Improved Rotary Sieve Method for Measuring State and Stability of Dry Soil Structure." *Soil Science Society of America Proceedings*, 16 (113).

Cowherd, C., Jr., G. E. Muleski, P. J. Englehart, and D. A. Gillette (1985). *Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites.* EPA/600/8-85/002. Washington, D.C.: U.S. EPA.

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Gillette, Dale (1978). "Tests with a Portable Wind Tunnel for Determining Wind Erosion Threshold Velocities." *Atmos. Environ.* 12:2309.

Owen, E. and R. C. Pankhurst (1969). *The Measurement of Air Flow.* Pergamon Press. London.

U.S. Environmental Protection Agency (1989). *National Technical Guidance Series Air Pathway Analysis Procedure for Superfund Applications*. Vol. II: *Estimates of Air Emissions at Superfund Sites*. EPA-450/1-89-002a.

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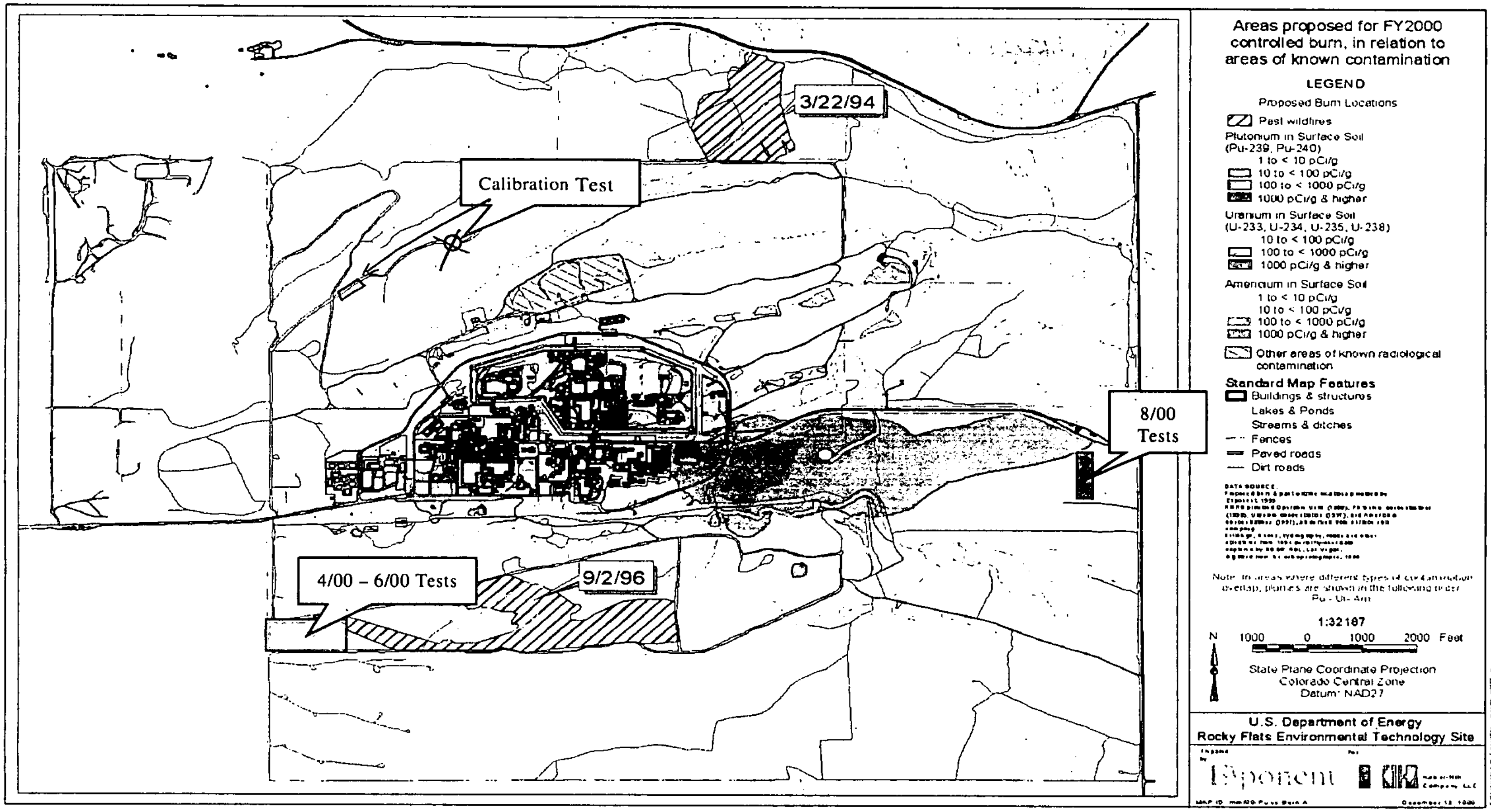

Figure 1-1. Overview Map of Site, Including Wind Tunnel Studies

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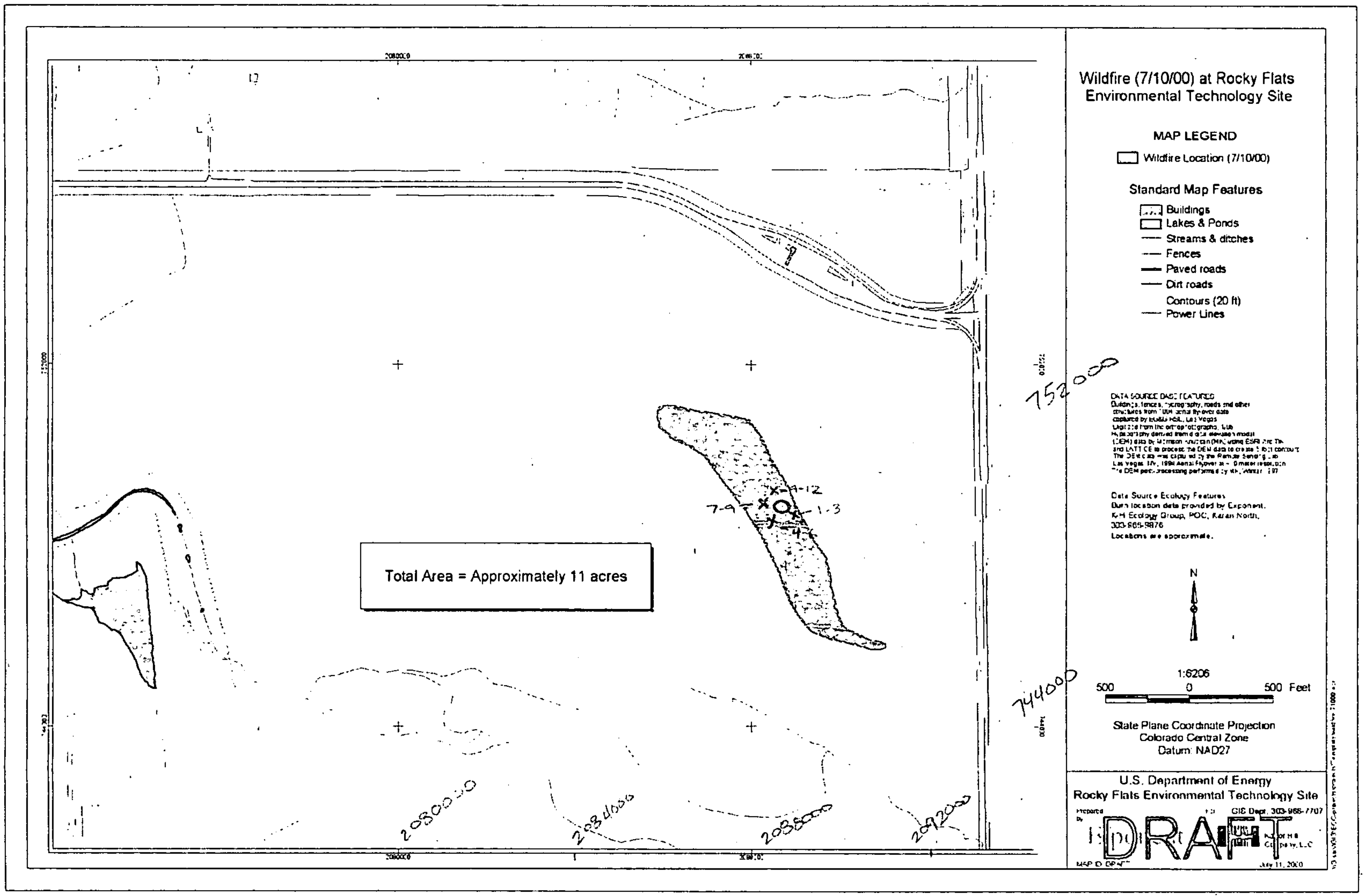

X - Approx. Soil Sample Loc.

O - Approx using Tunnel Sample Loc

Figure 1-2. Detail Map of Wildfire Study Area

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APPENDIX B

SITE ISOPLOTS, Pu-239 and Am-241

Figure B-11. Pu-239 Isoplot

Figure B-12. Am-241 Isoplot

Radian

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

C.O.C. # 00D1449#001

Collector	Contact/Requester NIELSEN, SKIP	Telephone No. 4289 MSIN FAX
RIN 00D1449	Sampling Origin	Purchase Order/Charge Code HAD213NB
Project Title BUFFER ZONE WILDFIRE PLOT (filters & whirl-pak smpls.)	Logbook No.	Ice Chest No. Temp.
To (Lab) S. Cohen & Associates	Method of Shipment	Bill of Lading/Air Bill No.
Protocol MONITORING		PRE

POSSIBLE SAMPLE HAZARDS/REMARKS
Are acid preserved samples DOT hazardous per 40 CFR Part 136.3 Table II? YES or NO
Are other known hazardous substances present? YES or NO
**
WIND TUNNEL SAMPLES ** ** 3 blank filters included.

SPECIAL INSTRUCTIONS Hold Time Total Activity Exemption: Yes ☐ No ☐

Filter No.	Location	Sampler	On Date	Off Date	No. Filters	Matrix	Sample Analysis	Preservative ; Packing
00D1449-001.001	CB-20-1		08/23/2000	08/25/2000	1	AIRFILTER	RC01B006 (Isotopic Air Filters) [Routine]	None None
00D1449-002.001	CB-20,21-BKG		08/23/2000	08/25/2000	1	AIRFILTER	RC01B006 (Isotopic Air Filters) [Routine]	None None
00D1449-003.001	CB-21-1		08/23/2000	08/25/2000	1	AIRFILTER	RC01B006 (Isotopic Air Filters) [Routine]	None None
00D1449-004.001	CB-22-1		08/23/2000	08/25/2000	1	AIRFILTER	RC01B006 (Isotopic Air Filters) [Routine]	None None
00D1449-005.001	CB-22,23-BKG		08/23/2000	08/25/2000	1	AIRFILTER	RC01B006 (Isotopic Air Filters) [Routine]	None None
00D1449-006.001	CB-23-1		08/23/2000	08/25/2000	1	AIRFILTER	RC01B006 (Isotopic Air Filters) [Routine]	None None
00D1449-007.001	CB-24,25-BKG		08/23/2000	08/25/2000	1	AIRFILTER	RC01B006 (Isotopic Air Filters) [Routine]	None None

Relinquished By: Date/Time	Received By: Date/Time	Relinquished By: Date/Time	Received By: Date/Time
Relinquished By: Date/Time	Received By: Date/Time	Relinquished By: Date/Time	Received By: Date/Time
Relinquished By: Date/Time	Received By: Date/Time	Relinquished By: Date/Time	Received By: Date/Time
Relinquished By: Date/Time	Received By: Date/Time	Relinquished By: Date/Time	Received By: Date/Time

FINAL SAMPLE DISPOSITION	Disposal Method (e.g., Return to customer, per lab procedure, used in process)	Disposed By	Date/Time

Radian

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

C.O.C. # 00D1449#001

RIN	Contact/Requestor	Telephone No.	MSIN	FAX
00D1449	NIELSEN, SKIP	4289		

Filter No.	Location	Sampler	On Date	Off Date	~~No. Filters~~ Bag	Matrix	Sample Analysis	Preservative; Packing
00D1449-008.001	CB-20-A1		08/23/2000	08/25/2000	1	SOLID	RC01B003 (Isotopic (Soil)) [Routine] Sample Mass = 245.3 mg	None None
00D1449-009.001	CB-21-A1		08/23/2000	08/25/2000	1	SOLID	RC01B003 (Isotopic (Soil)) [Routine] Sample Mass = 152.3 mg	None None
00D1449-010.001	CB-22-A1		08/23/2000	08/25/2000	1	SOLID	RC01B003 (Isotopic (Soil)) [Routine] Sample Mass = 42.6 mg	None None
00D1449-011.001	CB-23-A1		08/23/2000	08/25/2000	1	SOLID	RC01B003 (Isotopic (Soil)) [Routine] Sample Mass = 11.3 mg	None None

Relinquished By: Date/Time	Received By: Date/Time	Relinquished By: Date/Time	Received By: Date/Time
Relinquished By: Date/Time	Received By: Date/Time	Relinquished By: Date/Time	Received By: Date/Time
Relinquished By: Date/Time	Received By: Date/Time	Relinquished By: Date/Time	Received By: Date/Time
Relinquished By: Date/Time	Received By: Date/Time	Relinquished By: Date/Time	Received By: Date/Time

FINAL SAMPLE DISPOSITION	Disposal Method (e.g., Return to customer, per lab procedure, used in process)	Disposed By	Date/Time

Property Waste SampleXX

RELEASE EVALUATION FORM

Release Evaluation No.:000821-T130C-002 EXTENDED YES EXPIRES 31DEC2000 Charge No.:NA

PART I **SENDER/CUSTODIAN ACKNOWLEDGMENT**

Description of Property/Waste/Sample To Be Released/Transferred: AIR FILTER SAMPLES AND WHIRLPACK CONTAINERS OF AIRBORNE DUST SAMPLES . THESE SAMPLES ARE THE COLLECTION POINTS OF AIR SAMPLER (WIND TUNNEL). THESE SAMPLES WILL BE TAKEN IN THE BURN AREA AND OUTSIDE OF THE BURN AREA (SEE ATTACHMENT ONE ie, 8/00)

Current Location SOUTHEAST BURN AREA (see attachment one)

Destination S. COHEN AND ASSOCIATES, 1000 MONTICELLO COURT, MONTGOMERY ALABAMA, 36117, 1-334-272-2234

New Recipient/Custodian: : S. COHEN AND ASSOCIATES, 1000 MONTICELLO COURT, MONTGOMERY ALABAMA, 36117, 1-334-272-2234

History/Process Knowledge: THE SPECIFIED SAMPLES ARE BEING TAKEN AFTER A BRUSH FIRE THAT OCCURRED ON 7/10/00 ON THE SOUTHEAST PERIMETER OF RFETS.

Has the specified material ever been in an RMMA/RBA/CA or contacted DOE controlled radioactive materials? NO

1) By signing below, I certify information provided in Part I of this release evaluation to be true and accurate.
2) By signing below, I agree to comply with the specific requirements noted in Part II of this release evaluation

Sender/Custodian: Patrick Haines EMP NO: [redacted] Date 08/21/00 EXT 7240

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PART II RADIOLOGICAL ENGINEERING

SPECIFIC REQUIREMENTS AND/OR COMMENTS

1. Process history demonstrates THE ACTUAL AREA (SEE ATTACHMENT ONE) OF THE FIRE CONTAMINATION LEVELS HISTORICAL DATA HAS DEMONSTRATED THE AREA TO BE LESS THAN 10pci/gram.

2. If the area is characterized to be less than 10 pci/gram and we conservatively assign the area as 100 pci/gram THEN FINAL WEIGHT OF THE FILTER (AFTER SAMPLING)- MINUS THE TARE WEIGHT (JUST PRIOR TO SAMPLING)= 55 GRAMS

PROOF:

5.5 E3 pci/gram/ 1 E2 pci /gram= 55 gram difference would be equal to 2nci/gram

2. The SAMPLES listed above MEETS THE REQUIREMENTS OF THE 49 CFR DOT REGULATIONS TO BE SHIPPED AS LESS THAN 2 NANOCURRIES PER GRAM. PRELIMINARY STUDIES OF THE AREA IN WHICH THE SAMPLES ARE TO BE TAKEN DEMONSTRATE THAT THE AREA CONTAMINATION LEVELS ARE LESS THAN 10 pci/gram.

3. **A SURFACE CONTAMINATION SURVEY OF EACH SAMPLE CONTAINER SHALL BE PERFORMED. THE ACCEPTANCE VALUES SHALL BE LESS THAN 20dpm/100cm2 (ALPHA) AND 1000 dpm/100cm2 (BETA).**
4. **The sender/custodian shall provide a copy of the survey and release evaluation to Radiological Engineering.**
5. **CASI shall ensure that all radiological records are acceptable per the requirements of this release evaluation and shall provide a copy of all records when requested by radiological engineering**

SANFORD COHEN AND ASSOCIATES OPERATES UNDER THE STATE OF ALABAMA RADIOACTIVE MATERIALS LICENSE NUMBER 1150 AND EXPIRES ON SEPTEMBER 30, 2004

The samples specified in Part I of this release evaluation are being provided with authorization for transport as non-radioactive materials in accordance with Department of Transportation (49 CFR) regulations. This authorization for shipment does not constitute an unrestricted release.

Evaluated: [signature] Emp. No: [redacted] Date: 8/21/00 Ext: 6385
Radiological Engineer

APPROVAL FOR TRANSFER/SHIPMENT

Approved: Chad Blake Emp. No: [redacted] Date: 8/21/00 Ext: 5909
Radiological Engineer

SAMPLE RELEASE 000821-T130C-002

RSFORMS-09.01-01

PROPERTY/WASTE RELEASE EVALUATION SIGNATURE REQUIREMENTS

Release Evaluation #: 000821-T130C-002 PAGE 3 OF 3

Release Evaluation for Waste:

A Release Evaluation for Waste requires an evaluation and unrestricted release approval signature. The evaluation signature is by the Radiological Engineer (RE) providing the methods or criteria for unrestricted release (i.e., survey requirements, analytical requirements, no survey required, etc.). The unrestricted release approval signature for a Release Evaluation for Waste shall be a RE authorized to provide unrestricted release approval. In addition, the evaluation and unrestricted release approval signatures shall not be the same RE. The intent of this provision is to provide peer review of the evaluation and method of unrestricted release. It is important the RE take the peer review process seriously and not become a "rubber stamp" for their fellow engineer.

Release Evaluation for Property:

A Release Evaluation for Property requires an evaluation and unrestricted release approval signature. For a Release Evaluation for Property, the evaluation and unrestricted release signature may be the same RE. In the past, only one signature was required for property for which a RE could provide an unrestricted release on the basis of process knowledge/history.

Release Evaluation for Samples:

Samples are any waste or material that is being shipped to an off-site facility for analysis. Samples that may be provided with an unrestricted release using process knowledge/history or standard contamination survey techniques may be authorized for shipment to an off-site facility using the signatory requirements specified for property. Samples which cannot be provided with an unrestricted release using process knowledge/history or standard contamination survey techniques shall be authorized for shipment from the Site using the methodology specified for waste, i.e., second signature being provided by a RE authorized to perform peer review and approval for shipment.

The approval for transfer/shipment section of a Sample Release Evaluation (SRE) shall be revised as noted below for samples which cannot be provide with an unrestricted release.

"The samples specified in Part 1 of this release evaluation are being provided with authorization for transport as non-radioactive materials in accordance with Department of Transportation (49 CFR) regulation. This authorization for shipment does not constitute an unrestricted release."

Additional Documentation:

Number of lines per section may be modified or additional pages attached to ensure adequate documentation of information necessary to perform release evaluation.

Additional pages or attachments to a release evaluation shall have the evaluation number, Page __ of __, initials of Radiological Engineer signing approval for transfer/shipment and date.

ATTACHMENT ONE
1 of 1
8/21/00

RE 000821-T130C-002

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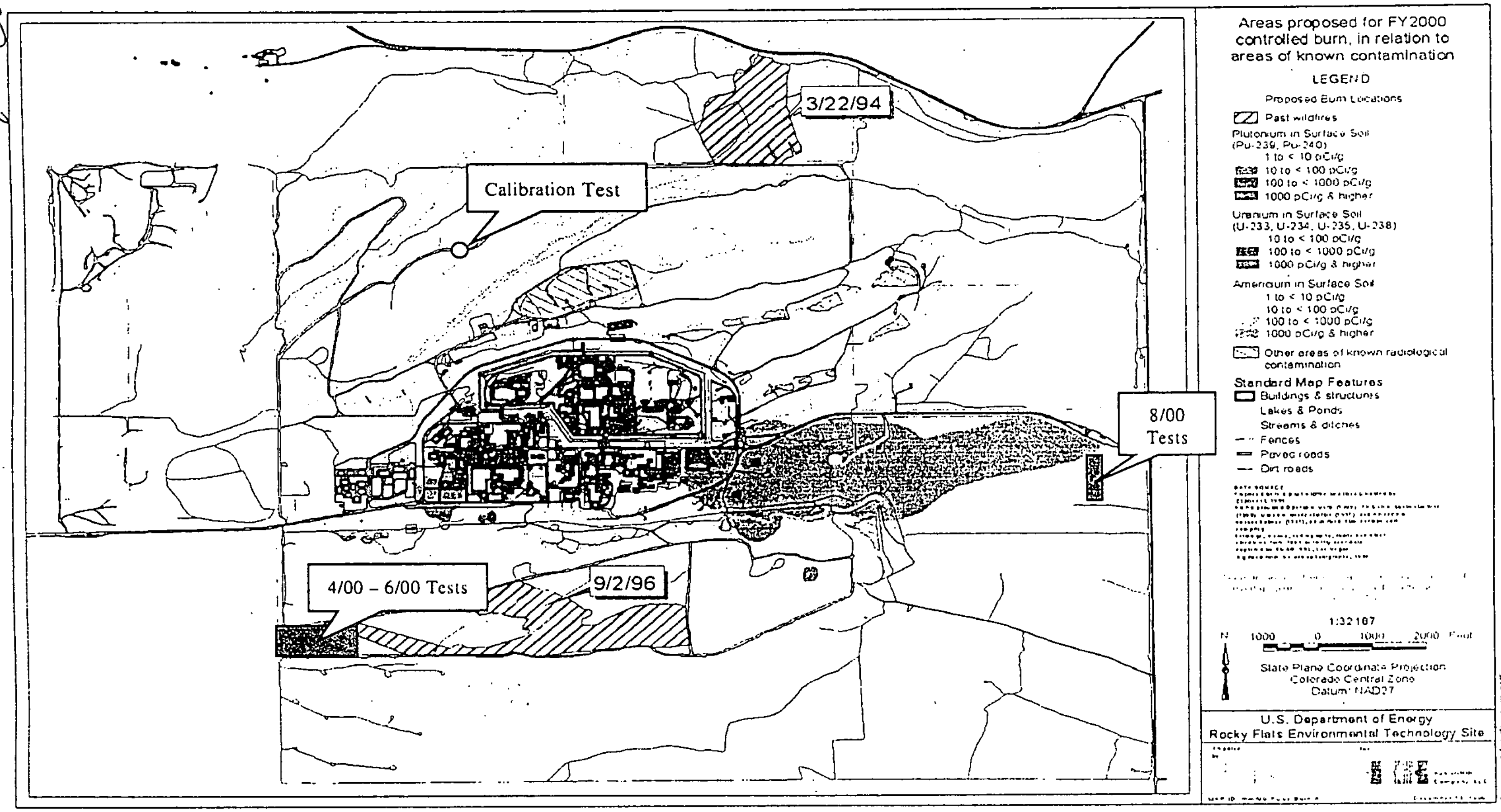


Figure 1-1. Overview Map of Site, Including Wind Tunnel Studies

COPY

RS FORMS 07.02-01

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

INSRUMENT DATA

Mfg. NE Tech	Mfg. N/A	Mfg. N/A
Model Electra	Model	Model
Serial# 1254	Serial#	Serial#
Cal Due 11-18-00	Cal Due	Cal Due
Bkg. 2.0α 471Bcpm	Bkg.	Bkg.
Efficiency 23, 32 β	Efficiency	Efficiency
MDA 40α 319β dpm	MDA N/A	MDA N/A
Mfg. N/A	Mfg. N/A	Mfg. N/A
Model	Model	Model
Serial#	Serial#	Serial#
Cal Due	Cal Due	Cal Due
Bkg.	Bkg.	Bkg.
Efficiency	Efficiency	Efficiency
MDA N/A	MDA N/A	MDA N/A

Survey Type: Direct α, β

Building: 549

Location: Conex

Purpose: Release

RWP #: N/A

Date: 8-28-00 Time: 0800

RCT: C.M. Lucero / [signature] / [redacted]
Print name Signature Emp. #

RCT: N/A / N/A / N/A
Print name Signature Emp. #

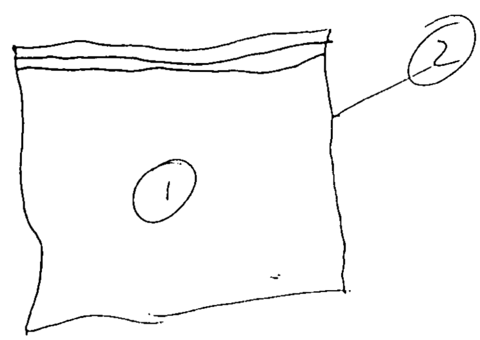
PRL #:

Comments: Outside Ziploc Bags surveyed no direct detected 8/28

SURVEY RESULTS

Swipe #	Location/Description Results in DPM/100CM^2	Removable Alpa	Removable Beta	Total Alpa	Total Beta
1	#37 Front	N/A	N/A	<40	<319
2	#37 Back			<40	<319
3	Remaining Front			<40	<319
4	Remaining Back	N/A	N/A	<40	<319
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A

Map



Date Reviewed: 8/28/00 RS Supervision: B. WILLIAMSON / [signature] [redacted]
Print Name Signature Emp. #

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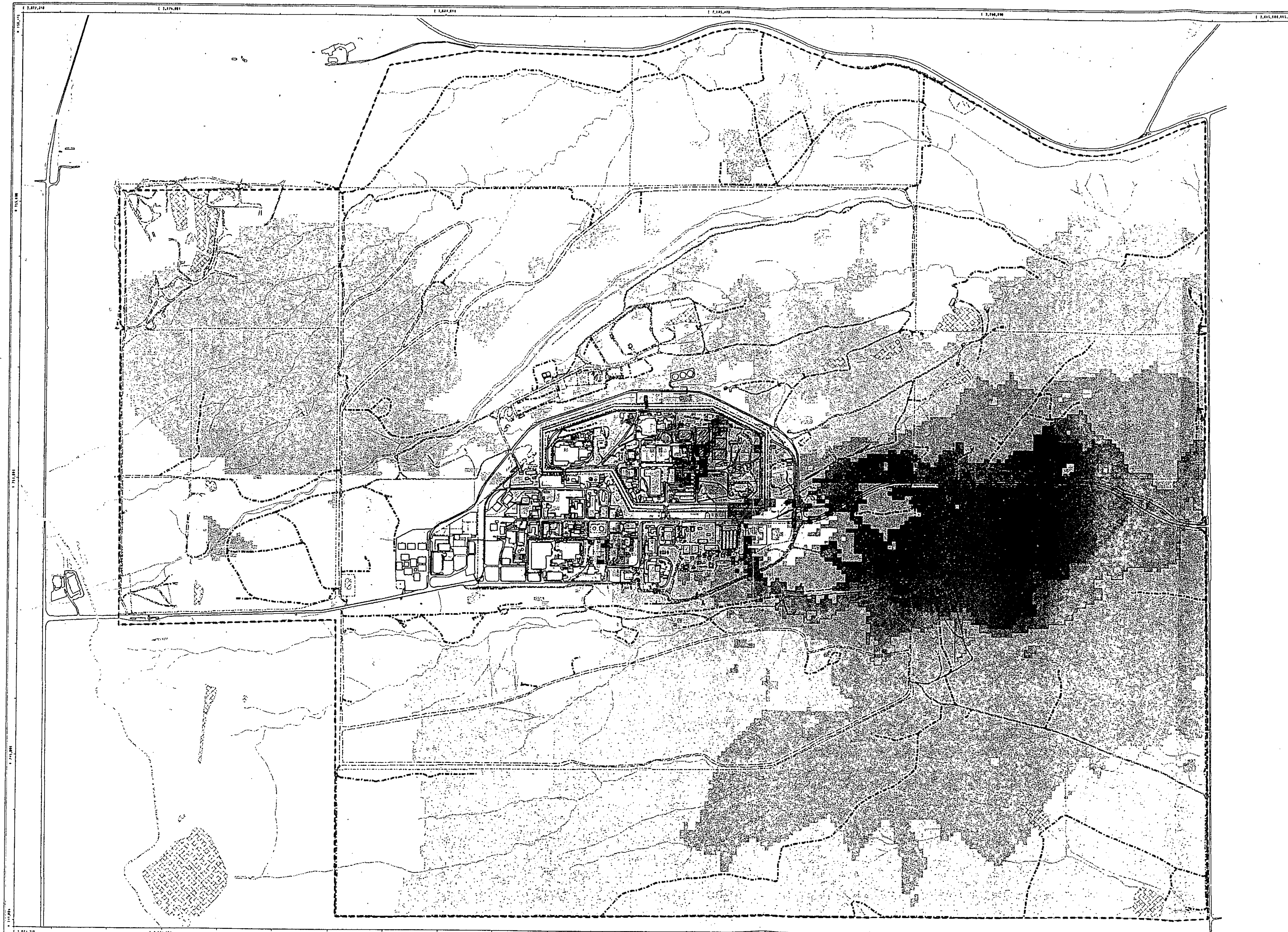

Figure B-11

Pu-239 Isoplot (pCi/g)
(1999 Kriging Analysis)

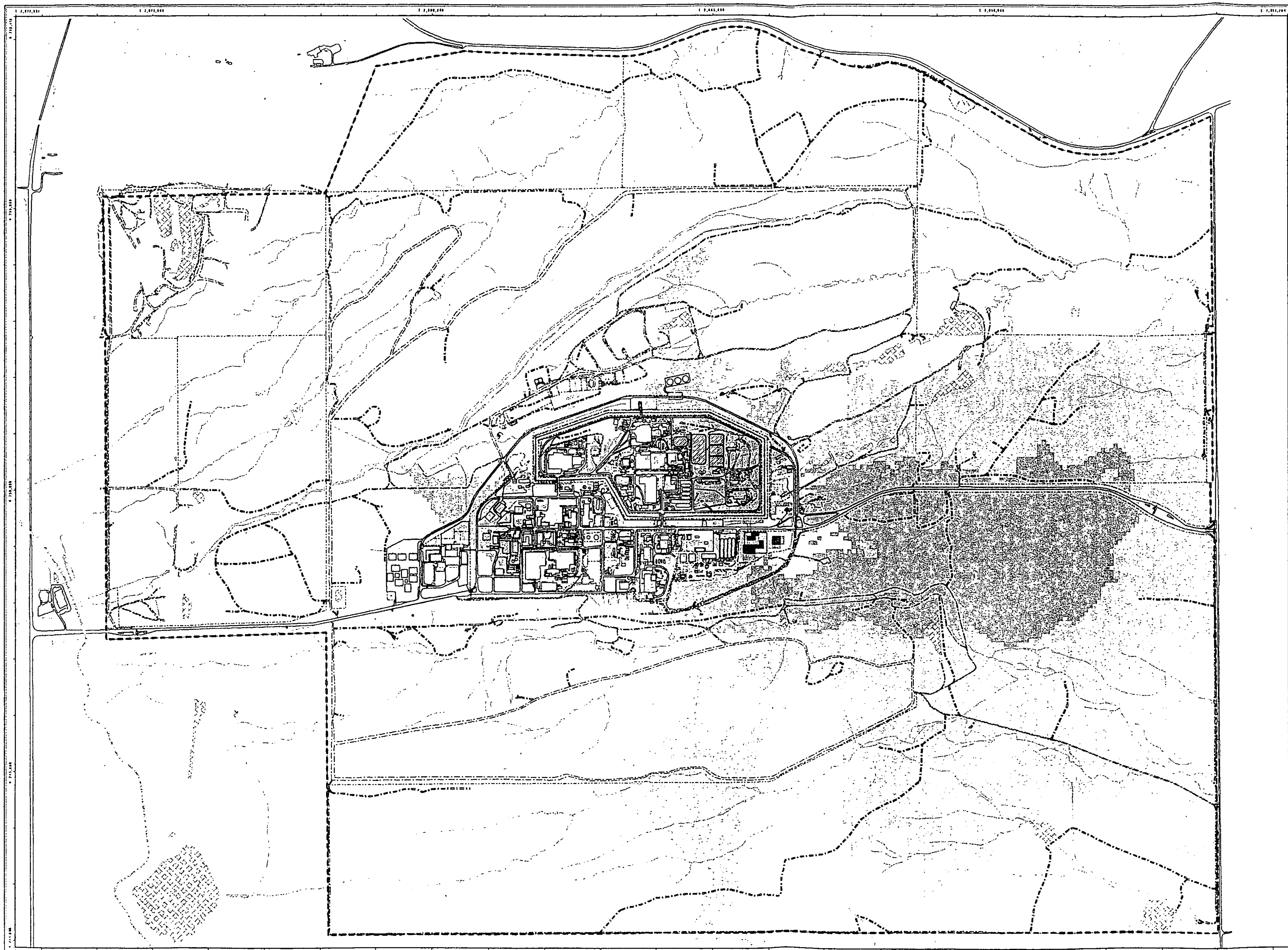

Figure B-12

Am-241 Isoplot (pCi/g) (1999 Kriging Analysis)

EXPLANATION

- < = 0.1
- > 0.1 and < = 1.0
- > 1.0 and < = 5.0
- > 5.0 and < = 10.0
- > 10.0 and < = 38.0
- > 38.0 and < = 215.0
- > 215.0 and < = 500.0
- > 500.0

Standard Map Features

- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Rocky Flats boundary
- Paved roads
- Dirt roads

DATA SOURCE BASE FEATURES:

Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Data Source:
AM-241 Kriging data approved by Win Chromec (RMRS, 303-966-4535).

Scale = 1 : 21330
1 inch represents approximately 1778 feet

500 0 1000 1800ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

GIS Dept. 303-966-7707

Prepared by:
DynCorp
THE ART OF TECHNOLOGY

Prepared for:

MAP ID: 2k-0048/am_grid.aml

July 06, 2000

NT_Svr h:/projects/fy2k/2k-0048/am_grid.aml

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